

Aspects of LSS Polarized DIS analysis

Elliot Leader

Imperial College London

Berkeley Workshop on Nucleon Spin Physics

June 2009

with thanks to

J.-P. Chen, S. E. Kuhn, A. V. Sidorov, D. B. Stamenov

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$$\approx \frac{A_{\parallel}}{d}$$

$$A_1 = \frac{A_{\parallel}}{D} - \eta A_2$$

$$A_1 \approx \frac{A_{\parallel}}{D}$$

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$$A_1 = \frac{g_1 - \gamma^2 g_2}{F_1}$$

and ignore g_2 term, or

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$$A_1 = (1 + \gamma^2) \left[\frac{g_1}{F_1} \right] + (\eta - \gamma) A_2,$$

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and ignore A_2 term but use its bound in systematic error.
Thus two approximations:

$$\frac{g_1}{F_1} \approx A_1 \quad \text{or} \quad \frac{A_1}{1 + \gamma^2}$$

$$\gamma^2 = \frac{4M^2 x^2}{Q^2}$$

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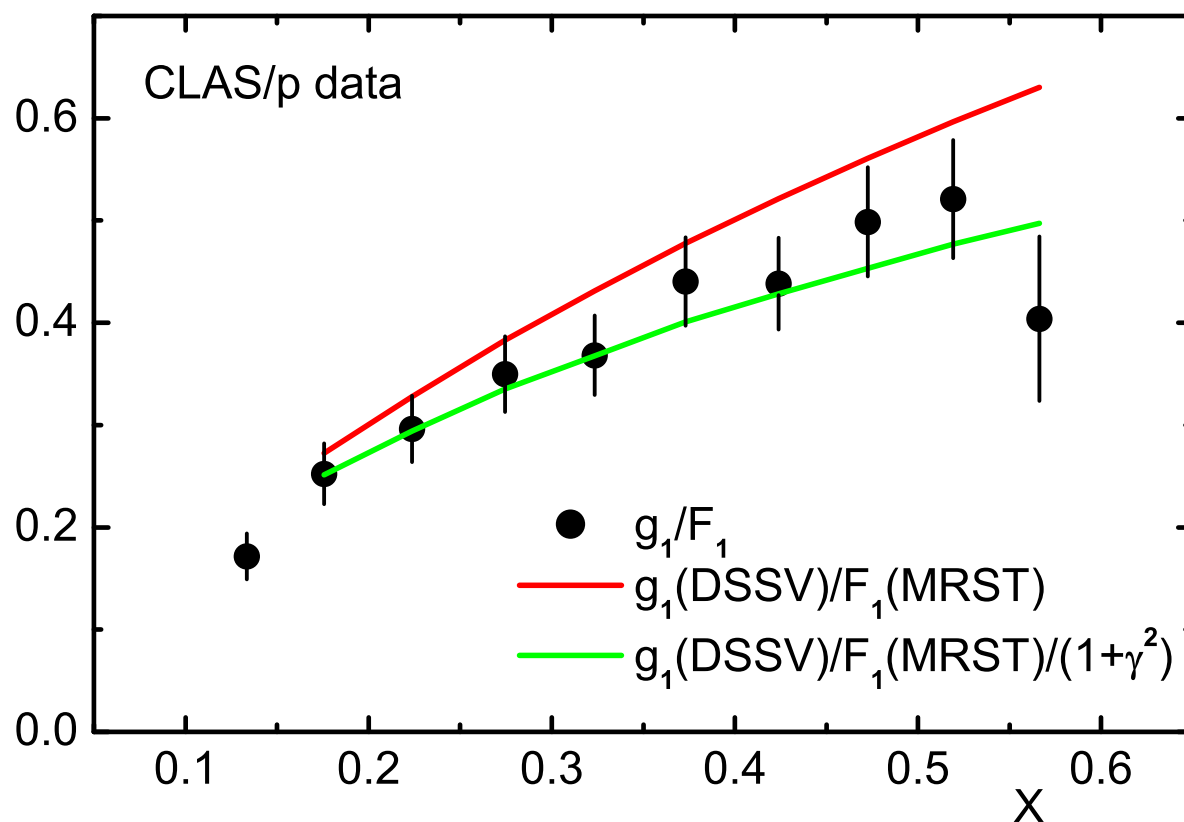
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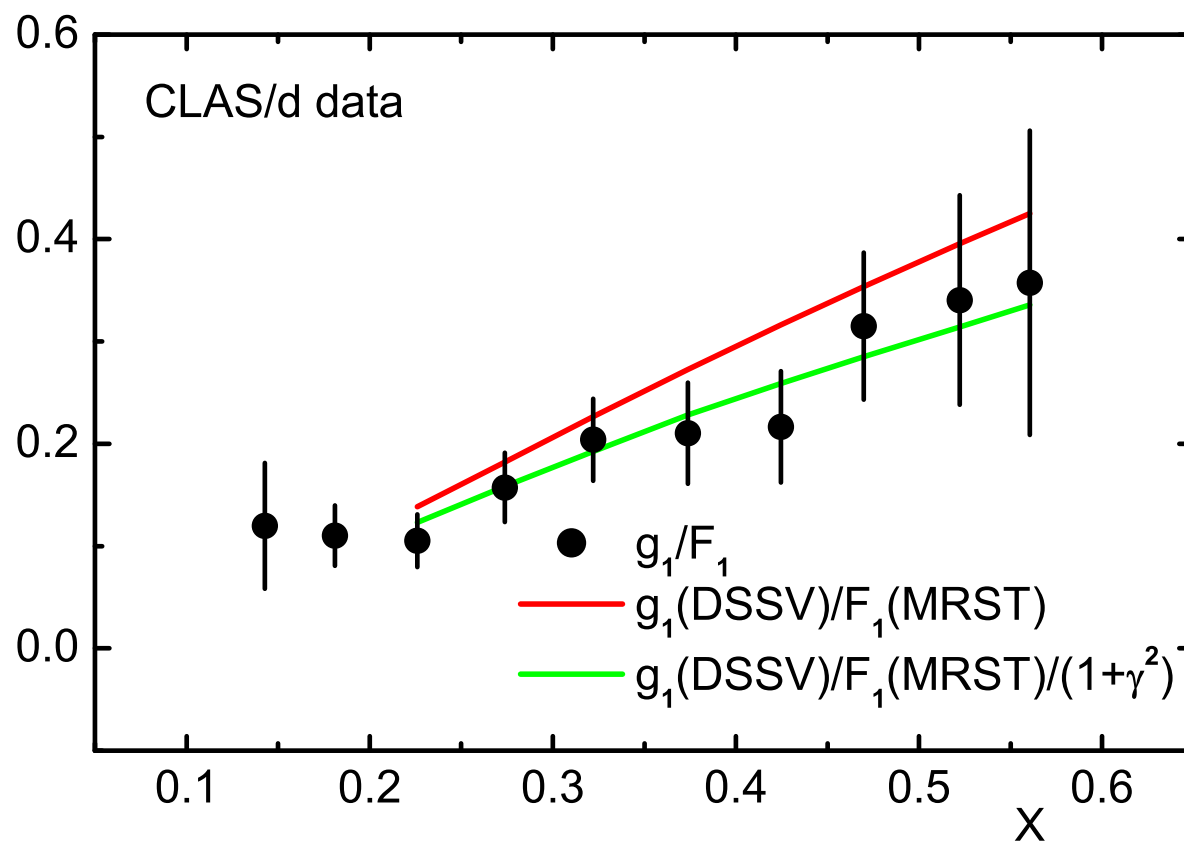
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Effect on PDFs ?????????? Look at CLAS proton and neutron data:

Compare $\left(\frac{g_1}{F_1}\right)_{DSSV}/(1 + \gamma^2)$ and $\left(\frac{g_1}{F_1}\right)_{DSSV}$ with $\left(\frac{g_1}{F_1}\right)_{Expt}$

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Comparison of χ^2_s for fit to $\left(\frac{g_1}{F_1}\right)_{Expt}$

Expt	$\left(\frac{g_1}{F_1}\right)_{DSSV} / (1 + \gamma^2)$	$\left(\frac{g_1}{F_1}\right)_{DSSV}$
p	5.9	20
n	2.5	8.2

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$$g_1^{EXP} = g_1^{LT} + g_1^{HT} \qquad F_1^{EXP} = F_1^{LT} + F_1^{HT}$$

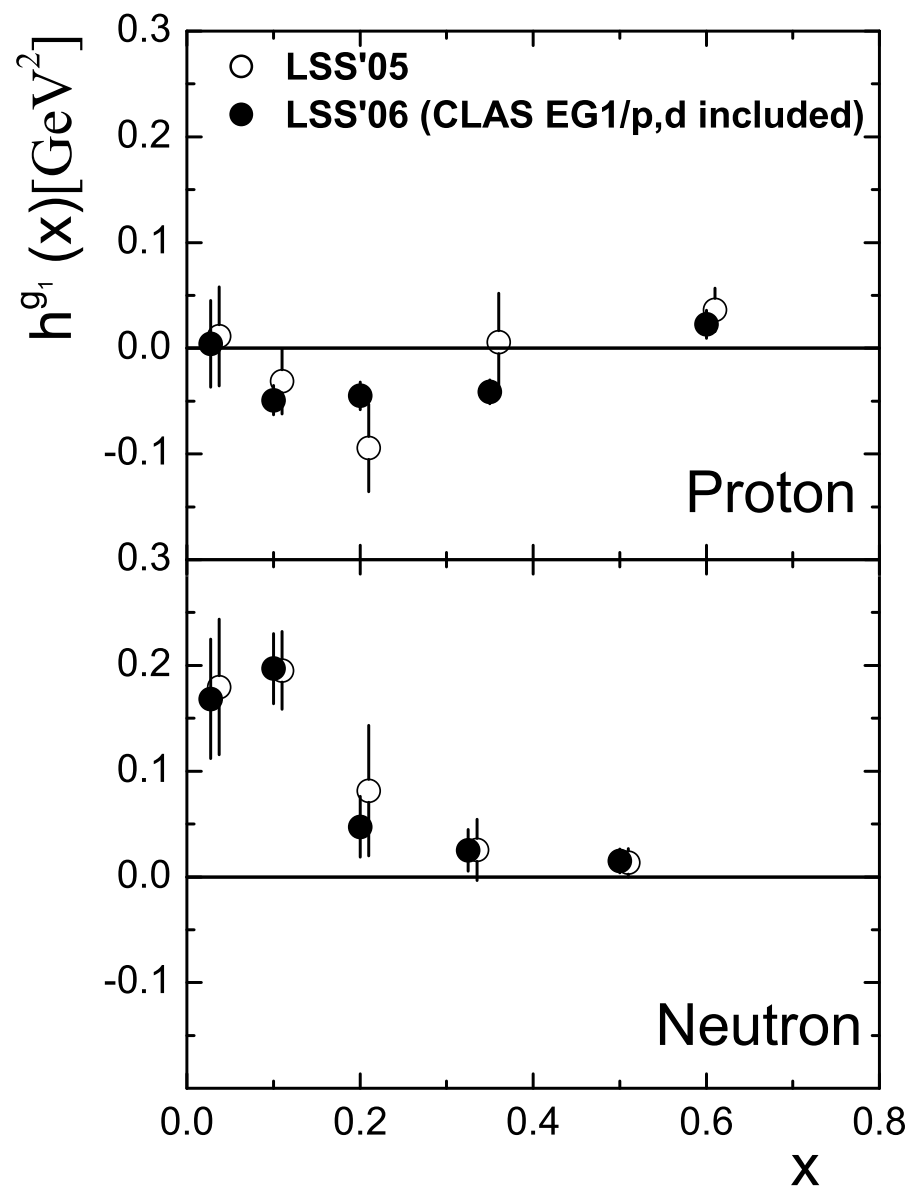
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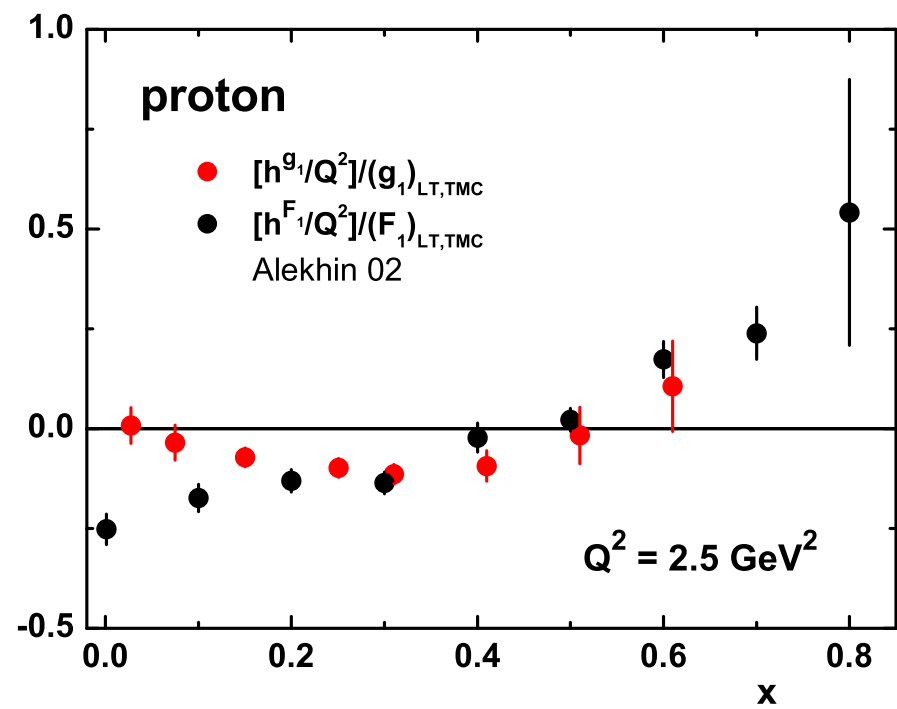
Long ago we discovered empirically that HT terms cancelled out in the ratio $\frac{g_1}{F_1}$. Put

$$g_1^{EXP} = g_1^{LT} + g_1^{HT} \quad F_1^{EXP} = F_1^{LT} + F_1^{HT}$$

$$\left[\frac{g_1}{F_1} \right]^{EXP} \approx \frac{g_1^{LT}}{F_1^{LT}} \left[1 + \frac{g_1^{HT}}{g_1^{LT}} - \frac{F_1^{HT}}{F_1^{LT}} \right] \approx \frac{g_1^{LT}}{F_1^{LT}}$$

provided there is a cancellation between $\frac{g_1^{HT}}{g_1^{LT}}$ and $\frac{F_1^{HT}}{F_1^{LT}}$.





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How will this affect the DSSV PDFs??

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$$\Delta q(x)|_B = T_{B \leftarrow A} \Delta q(x)|_A. \quad (3)$$

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$$\Delta q(x)|_B = T_{B \leftarrow A} \Delta q(x)|_A. \quad (4)$$

Suppose now that $T_{B \leftarrow A}$ is known to NLO accuracy, and the parton densities are extracted from the data, *independently*, in NLO, using schemes A and B , with results $\Delta q(x)|_{A,B}^{data}$, respectively.

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$$\Delta q(x)|_B^{data} = T_{B \leftarrow A} \Delta q(x)|_A^{data}. \quad (7)$$

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Thus the ratio

$$\frac{\Delta q(x)|_B^{data} - T_{B \leftarrow A} \Delta q(x)|_A^{data}}{\Delta q(x)|_B^{data} + T_{B \leftarrow A} \Delta q(x)|_A^{data}}$$

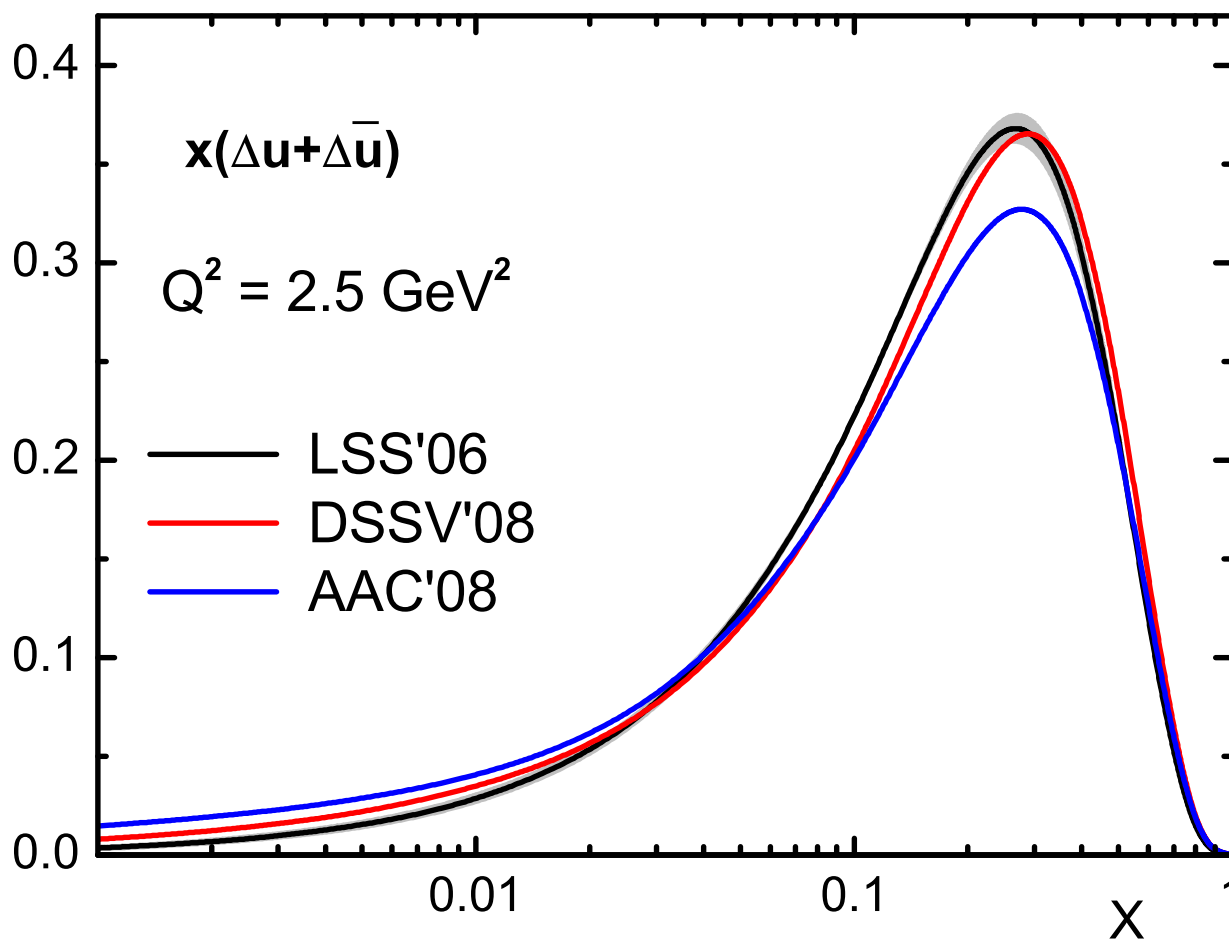
gives some indication of the reliability of the parton densities.

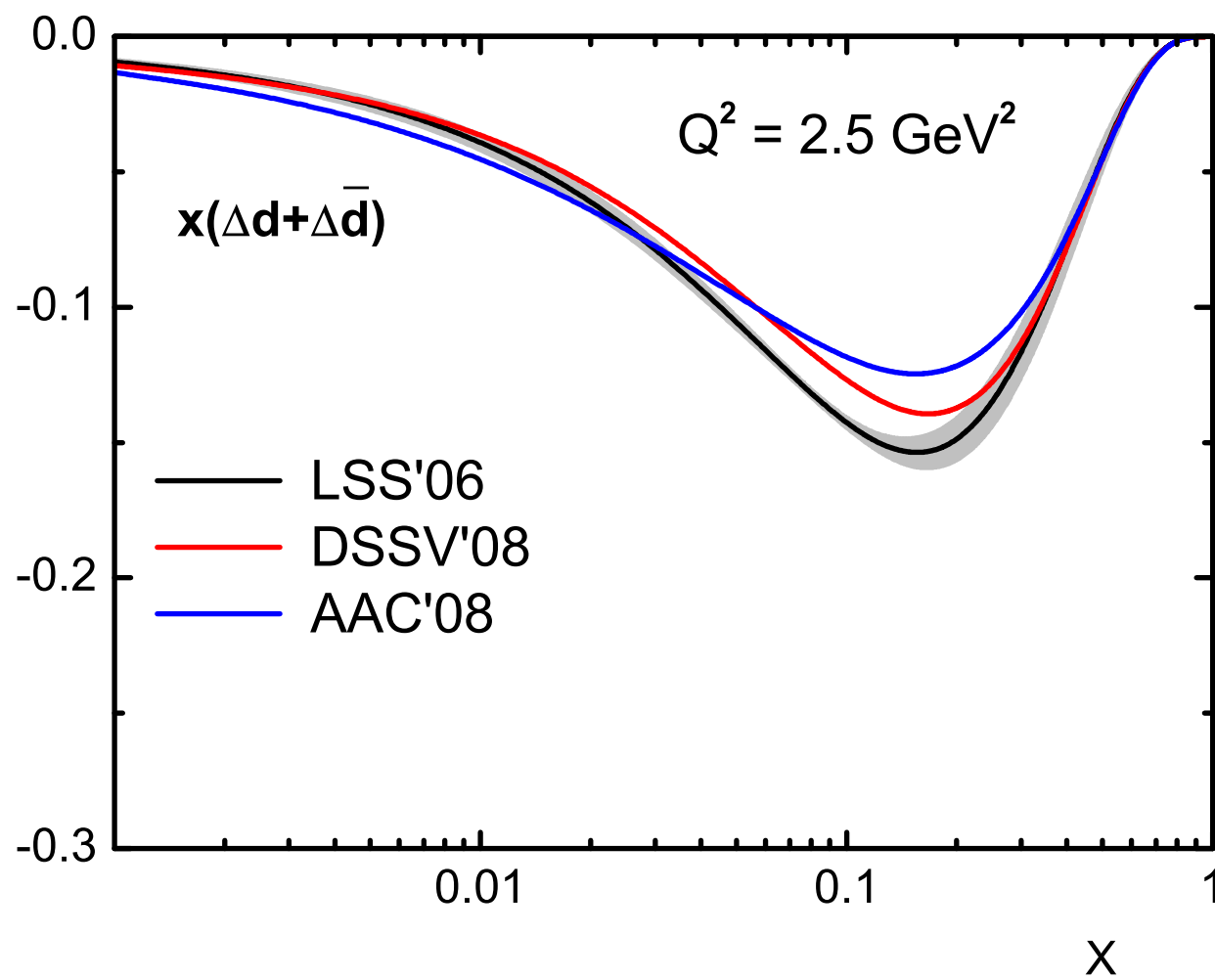
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$$\Delta S_{\overline{MS}} = -0.126 \pm 0.010 \quad \text{at} \quad Q^2 = 1 \text{ GeV}^2 \quad (15)$$

It was shown that a positive value for the first moment would imply a huge breaking of $SU(3)_F$ invariance, far greater than the $\pm 10\%$ breaking estimated by Ratcliffe

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$$\Delta S = 0.037 \pm 0.019(stat.) \pm 0.027(sys.) \quad (17)$$

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However, the DSSV combined analysis (DIS, SIDIS, $pp \rightarrow \pi$) also finds positive values for $\Delta_s(x) + \Delta_{\bar{s}}(x)$ for $x \geq 0.03$, yet ends up with a negative first moment

$$\Delta S = -0.114 \text{ at } Q^2 = 10 \text{ GeV}^2.$$

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COMPASS (Windmolders) study dependence of $\Delta s(x) + \Delta \bar{s}(x)$ on the choice of fragmentation functions.

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Plot integral over measured range vs $R_{S/F}$

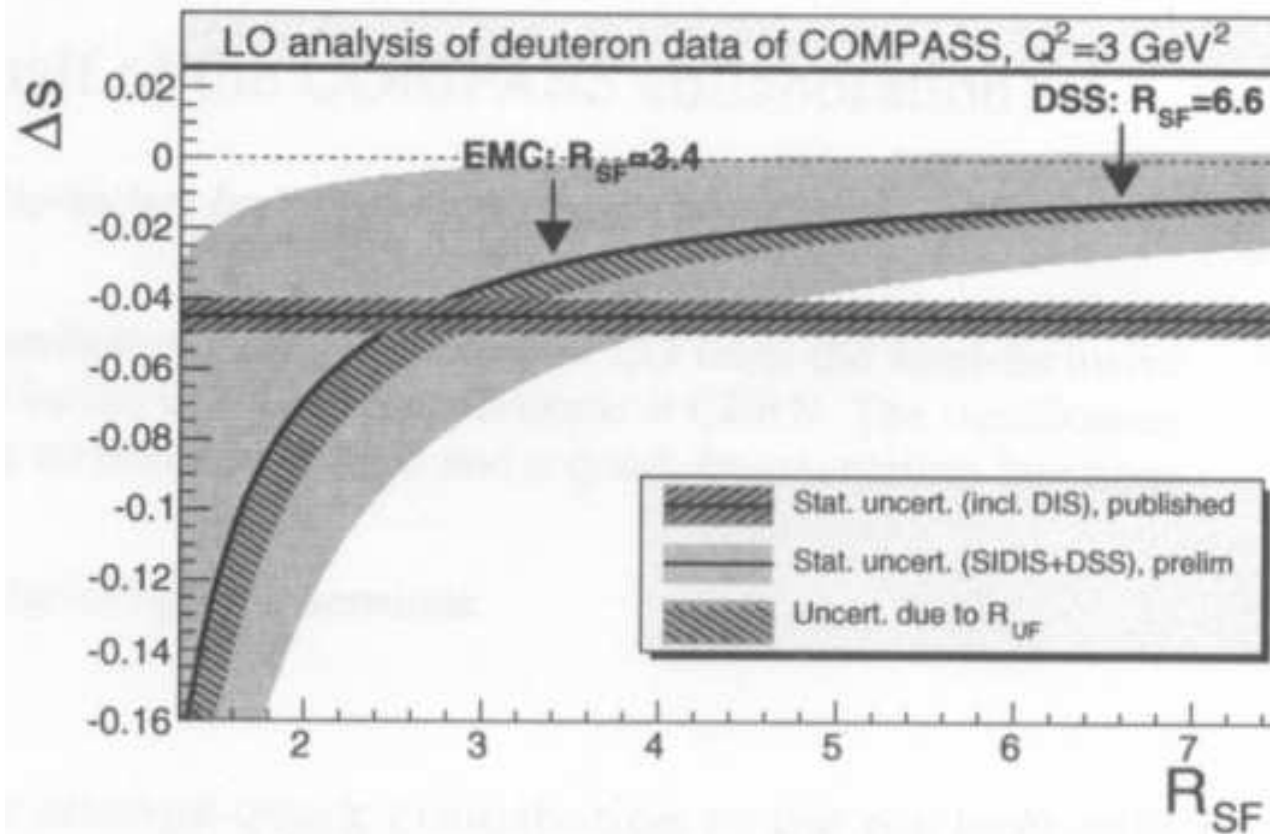
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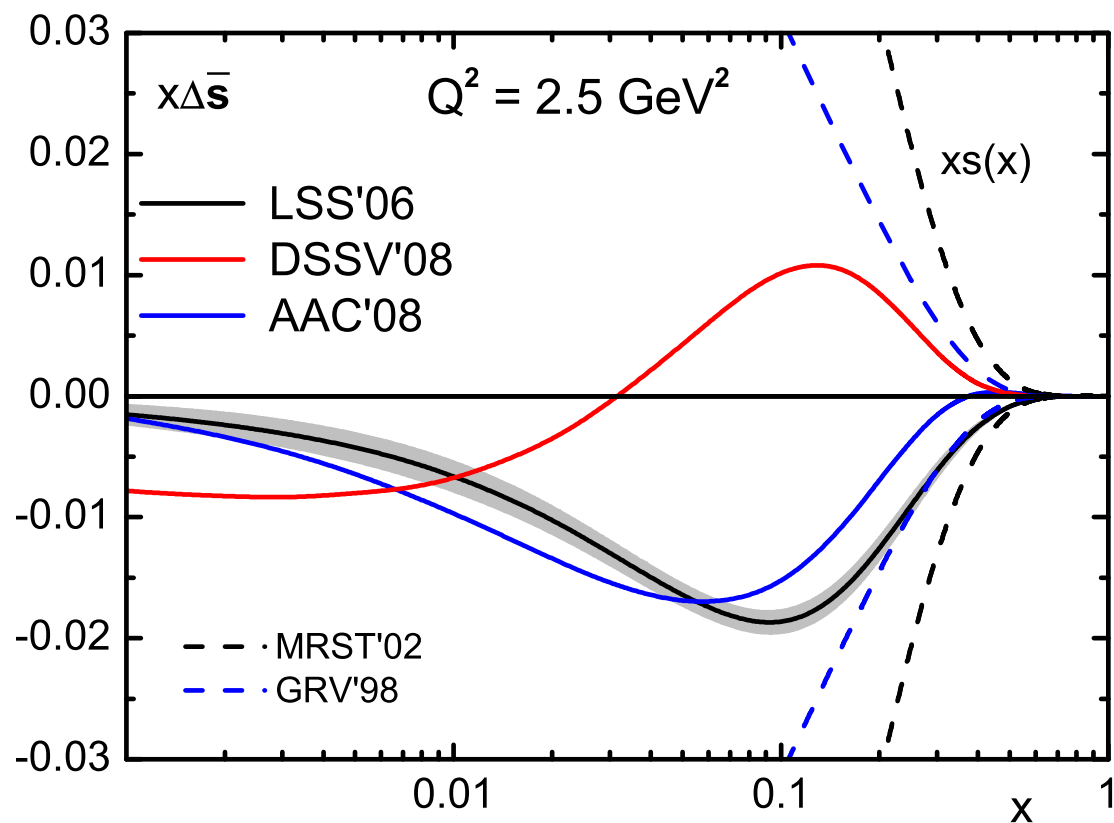
Result sensitive to $R_{S/F}$



Main curve uses $R_{U/F} = 0.14$ (DSS value); hatched uses 0.35 (SMC value).

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COMPASS $\Delta\Sigma(Q^2 = 3) = 0.35 \pm 0.06$

HERMES $\Delta\Sigma(Q^2 = 5) = 0.33 \pm 0.04$

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Two standard deviations difference! No explanation.

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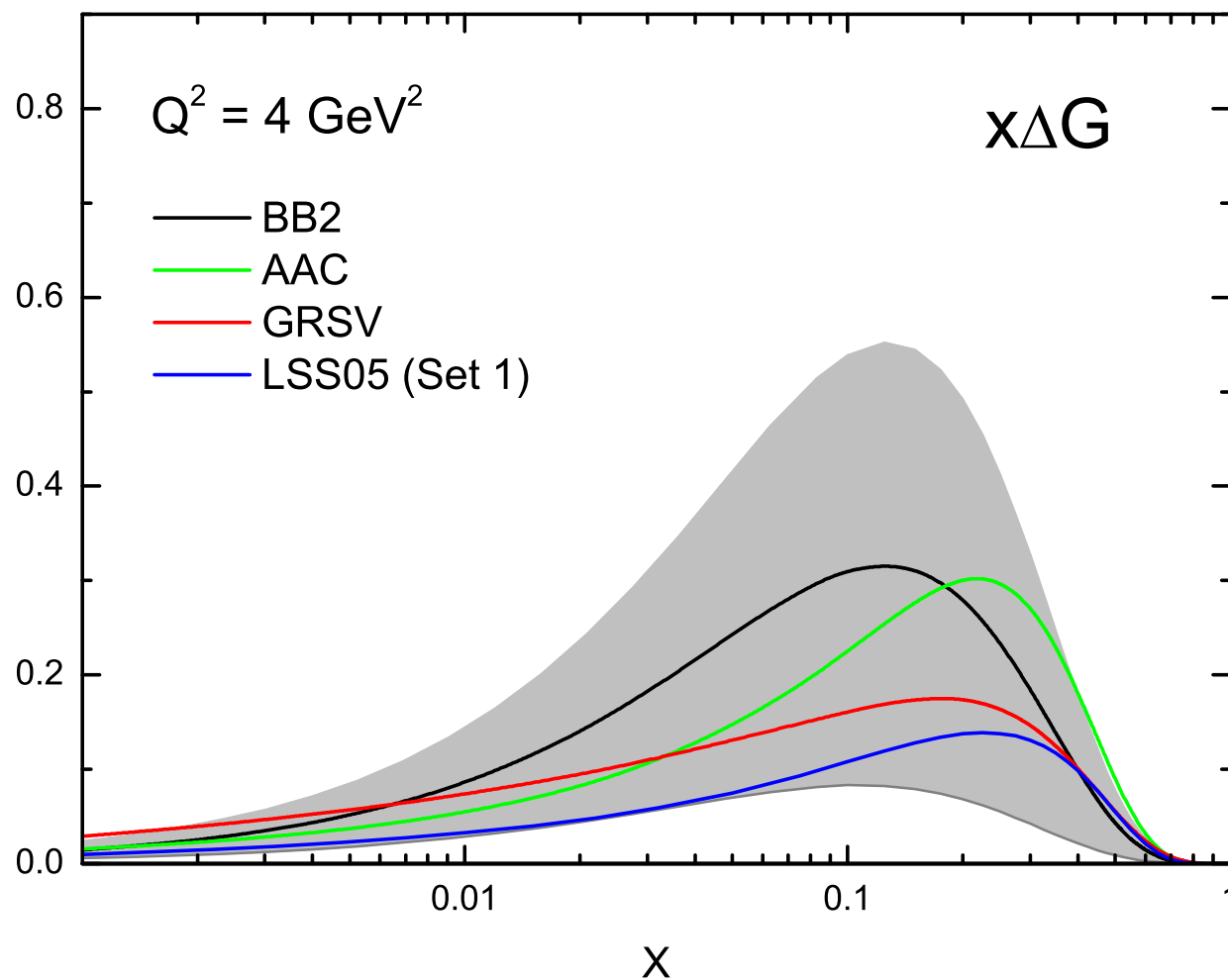
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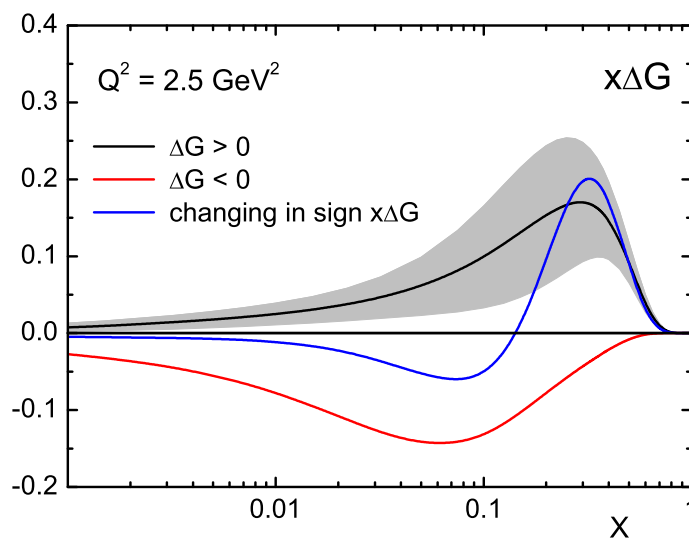
For a long time all analyses seemed to indicate that $\Delta G(x)$ was a positive function of x .

ΔG a few years ago:



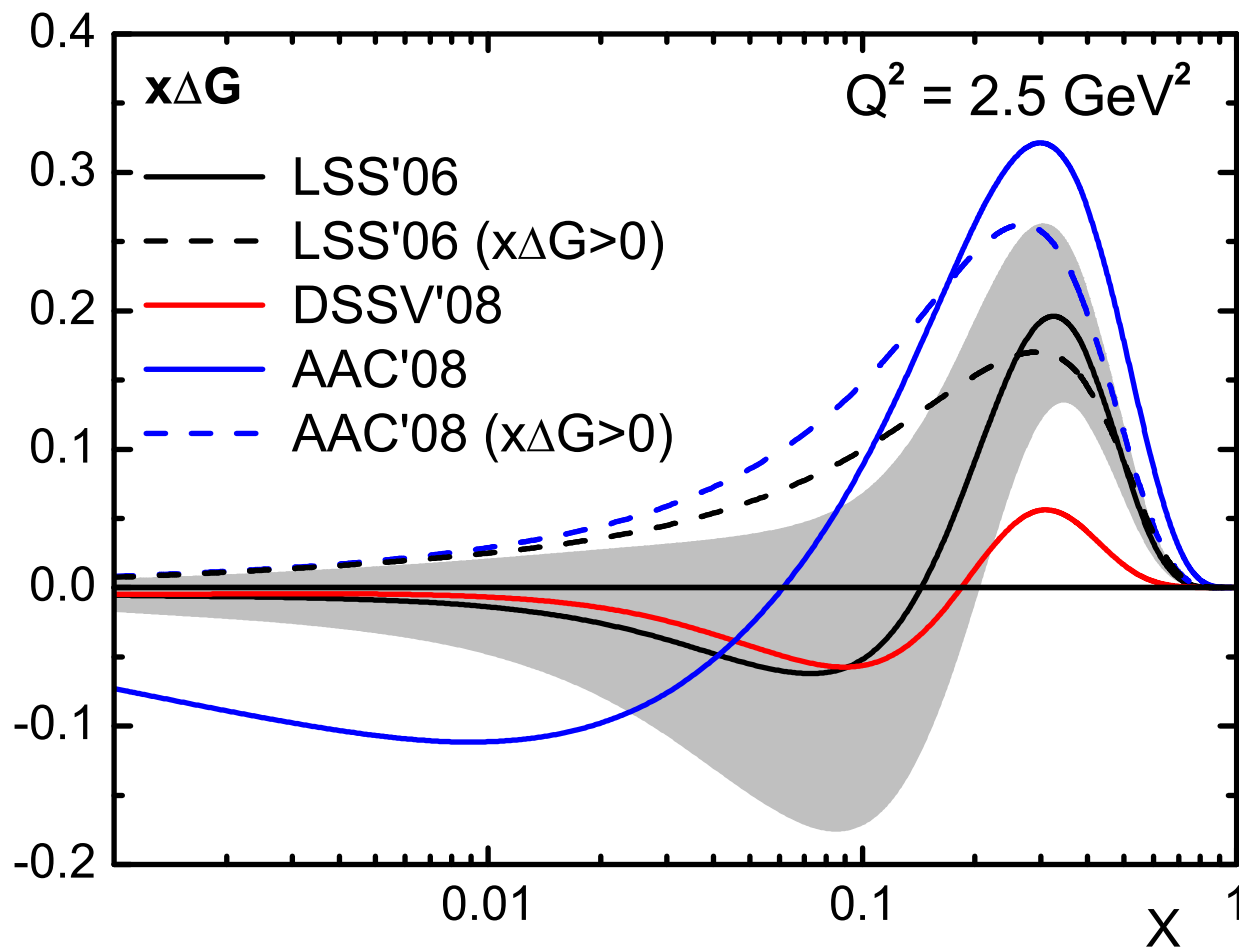
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- Need to understand disagreements in first moment $\Delta\Sigma$ obtained from HT expansions.

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(2) **IF** assume $\Delta\Sigma|_{JET} \Leftrightarrow 2S_z^{quarks} \approx 60\%$

then need $\Delta G \approx 1.7$ at $Q^2 = 1\text{GeV}^2$

Much bigger than present values!